

MODELING OF ACTIONS TO TAKE AFTER A SCORPION STING AND DEVELOPING A WEB BASED INFORMATION SYSTEM TO TRACK THE DIFFERENT INDICATORS SYSTEMATICALLY

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Abstract

To take the quickest and the correct decision when a scorpion stings is decisive in terms of patient rescue. Based on a long experience and collected information about envenomation, Anti Poison and Pharmacovigilance Center of Morocco (CAPM) developed a guideline with clear actions to help the patients.

The application of information technology in health sector has grown exponentially over the last years. This research aimed to model a health care system and make it easier to use by the health professionals. It will allow the clinician to monitor the evolution of the different vital signs and eventually suggest the best hospitalization (type of drug, reanimation, release...). The main objective is to improve effectiveness and efficiency.

The developed application contains sensible data, therefore the general concept is constructed to be secure. Furthermore, it is web oriented, in order to facilitate the communication between the various sanitaire structures. The program helps enormously to gather important statistics and analysis.

Keywords: Modeling, anti poison centre, scorpion sting, vital signs, eHealth

Introduction

Morocco is one of the Mediterranean countries which are recorded the largest number of scorpion stings: 30,000 cases per year where 0.3 % of them are deaths. Luckily this ratio is continuing to decrease due to an adopted national strategy. (Soulaymani R. et al ,2008)

The scorpion sting is the leading cause of poisoning in Morocco before damaged food or chemical suicide. The most affected region is El Kelâa Des Sraghnas in Marrakech (Nekkal et al, 2013). Several studies clearly showed that scorpion envenomation remains a public health problem in Morocco. Favorable evolution was in 90.3% of cases but 87 deaths were recorded (9.7%) from 2002 to 2006 (Rhazi et al, 2011).

Till now, all data of poisoning or envenomation report sheets, filled in by the doctor in charge of the case or by the nurse, is coming from health facilities - in sixteen Moroccan regions - to the Toxicovigilance unit of the center irregularly (Rebgui, 2013), which is time and cost consuming. To overcome the hurdles introduced with the delay, a new approach is needed. Thanks to this new realized information system, CAPM will centralize the information instantly and then can define the adequate strategy to battle against envenomation.

The main objective is to setup an effective and efficient information system, which support essentially the data management, measurement, monitoring and guidance. The different indicators and metrics can be tracked automatically and anytime from the integrated database.

Materials and Methods

Scorpion sting causing envenomation represents a public health problem, particularly in the countries of North Africa, the Middle East, South America and India (Soulaymani R. et al, 2008) with consequences in

mortality (Faraj, 1994), morbidity (Nolf, 2005), and public health costs (Rhazi et al, 2011).

The Moroccan CAPM's retrospective and prospective studies showed the nature and timing of clinical events in scorpion envenomation, as well as the clinical and therapeutic severity levels of the epidemiology (Nolf, 2001). On this basis, the CAPM has developed a guideline "Conduite A Tenir" (CAT) to support stung patients. This standardization was part of the (Hmimou et al, 2009) developed national strategy against the scorpion stings and envenomation. Other components are trainings, awareness and establishment of an information system to track the different epidemic's indicators especially morbidity and lethality (Soulaymani R., 2005).

The present document demonstrates software named "ES System" that supposed to help taking easily the exact and quick therapeutic decisions after a scorpion stings or after an envenomation. This makes the therapy reliable and efficient.

A. Guidelines:

The guideline is based on an algorithm to distinguish between a stung and non-stung patient. The non-stung patients are monitored for the four-hours following the injection, whereas the stung patients are transferred to an intensive care unit (ICU) for rehabilitation (Soulaymani R., 2003).

The venom is a mixture of compounds (neurotoxins, enzyme inhibitors, etc.) each not only causing a different effect but possibly deadly to humans. The clinical condition of a patient allows differentiating three classes. Classifying a patient is an ongoing process; we should note that during the treatment, the patient's class can be changed.

Class 1 (simple sting): Characterized by the presence of one or more local symptoms (pain, redness, swelling, numbness, etc.) (Ouammi, 2009)

Class 2 (poisoned sting): Characterized by the presence of one or more general signs (temperature, nausea, vomiting, abdominal pain, diarrhea, impaired arterial pressure, respiratory disorders ...). Predictable severe signs are essentially: priapism, vomiting, sweating, fever > 39 ° C (Soulaymani R., 2004), Age ≤ 15 years (Soulaymani R., 2008).

Class 3 (severe poisoned sting): Characterized by the failure of at least one vital functions (Cardiovascular, Respiratory, Neurological) (Soulaymani R., 2007). The severity is determined by the score of Glasgow, which varies from 3 to 15. Each response to a stimulus corresponds to a point, the sum of points is the degree of Glasgow. This allows seeing the state of consciousness of the patient. The different Glasgow's levels are recorded in the specific table in the database named Glasgow.

The guidelines following a sting are modeled in a flow diagram (Fig 1).

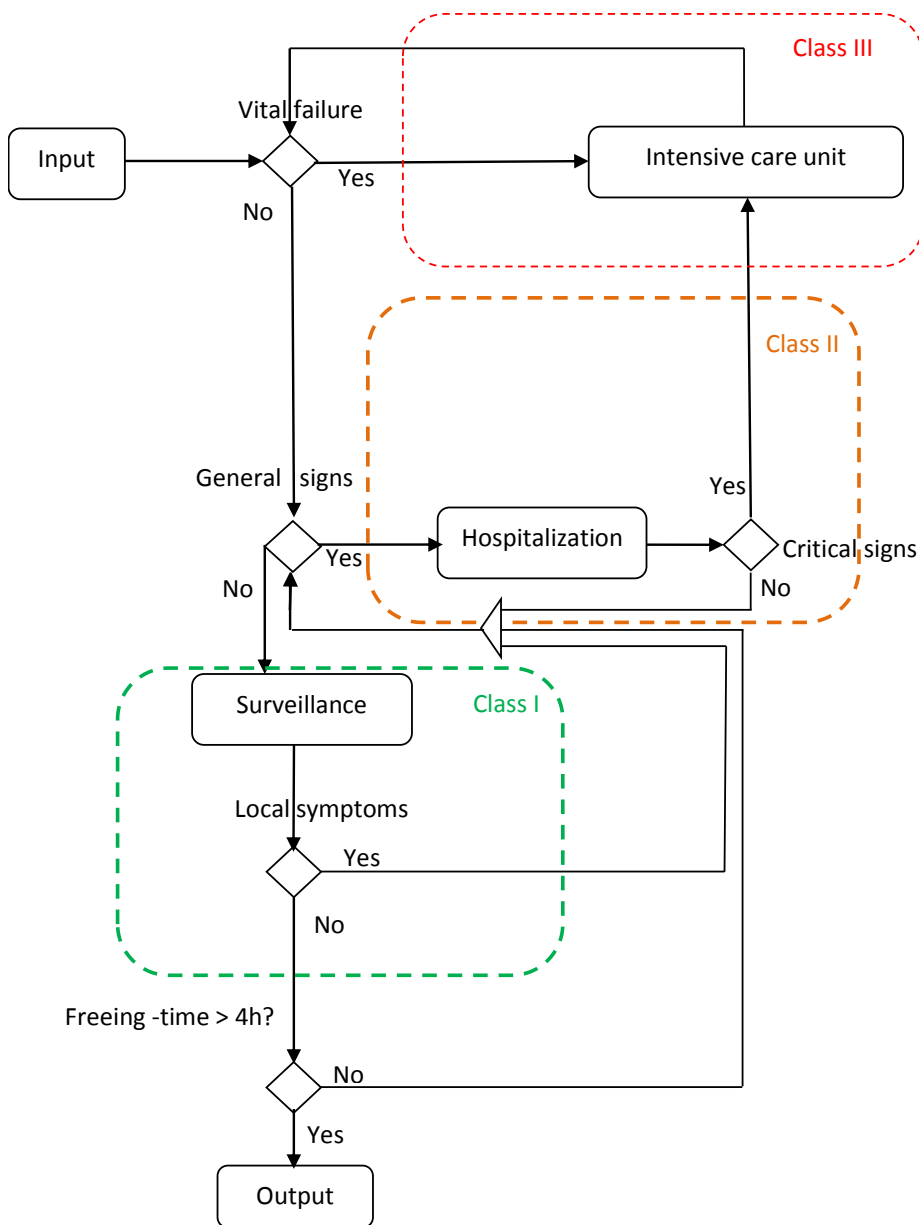


Fig 1: Schematic representation of a sting handling process

Freeing-time: time since the scorpion sting.

The patient will be hospitalized if a general sign exists, otherwise the surveillance is required.

Hospitalization:

When a stung patient arrives to a sanitary unit the following should be checked (Ouammi, 2009):

- If vital failure (Cardio, respiratory, Neuronal) is detected, the patient is conveyed immediately to an ICU.
- Reassure the patient and confirm the sting
- Specify the conditions of the sting: (Geographic location, date and time, circumstances);
- Note the Post Sting Time (PST);
- Verify the existence of general signs;
- Identify risk factors: young age, origin, type of scorpion ... (Rebgui et al, 2013).

Surveillance:

Specify the part of body affected by the sting;

- Look for local symptoms
- Look for regional symptoms.

General Signs:

If the clinician detects general signs, first, assess level of consciousness (Glasgow score): The Glasgow Coma Scale is a 15-point scoring neurological system designed to give a reliable procedure to define the conscious state of a patient (Soulaymani R. et al, 2004). The goal is to assess whether the patient's condition is stable, improving or deteriorating. Secondly, look for critical signs, those signs are indicative of the health status and patients well-being. Below are the norms

Temperature (° C):

- 36 to 37 °C

Heart rate (beats / min):

- Child: 70 to 140 beats /min
- Nursling: 100 to 160 beats /min
- Newborn < 1 week : 120 to 160 beats /min

Respiratory rate (cycle / min)

- Child : 20 to 30 cycle /min
- Nursling: 30 to 40 cycle /min
- Newborn < 1 week : 40 to 60 cycle /min

Blood pressure (maxima / minima):

- Systolic pressure: 14
- Diastolic pressure:8

B. Implementation:

eHealth is the use of emerging information and communications technology, especially the Internet, to improve or enable health and

healthcare (Pagliari et al., 2005). The Model is implemented as a web application using the XAMPP package which includes the Apache web server, the MySQL database server and the PHP engine. The used versions are:

APACHE 2.4.4: Apache is the most popular HTTP web server that is distributed under an "open source" license. It allows a computer to host a web application that can be accessed over the authorized network using a Web browser like chrome, Firefox or Internet explorer.

MYSQL 5.6.12: A database is a structured collection of data and information. Furthermore, MySQL is an Open Source SQL database management system; it enables storing data in separate tables and in a relational form. SQL is standardized by the ANSI/ISO SQL Standard to access databases and manipulating the stored data.

PHP 5.4.14: PHP stands for Hypertext Preprocessor is a server-side scripting language designed essentially for web development. With this way PHP generate HTML which is then sent to the client and displayed in the final user browser. It is a widely-used open source general-purpose.

C. The information system's architecture

Clients are connected to the server in three tier architecture (Fig 2). The user interface, the middle dynamic content and data store can be developed and maintained separately in a modular way.

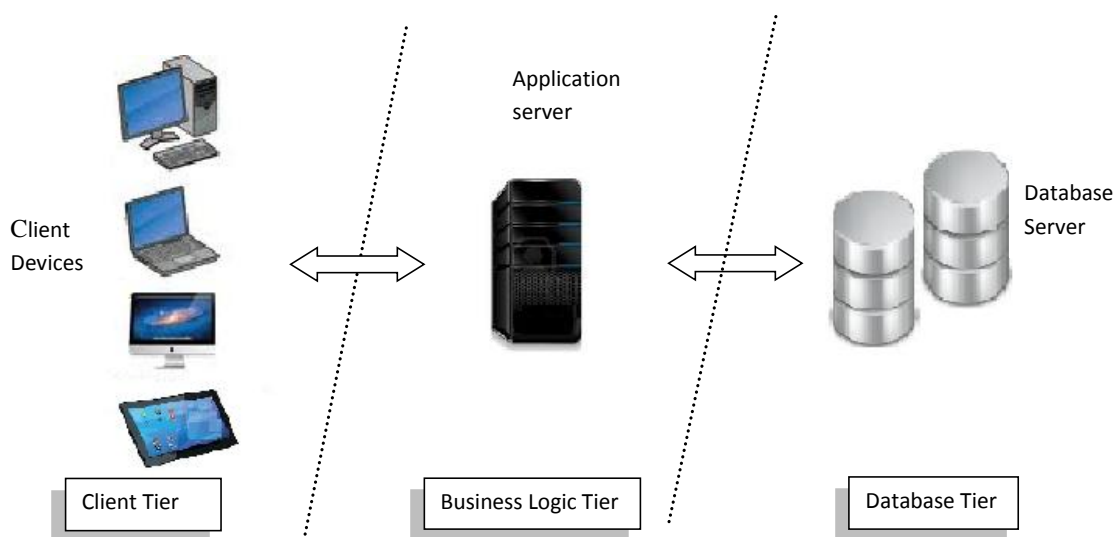


Fig 2: Three tiers architecture
The used architecture involves 3 layers:

Client Tier: are browsers from end user side, they can be connected from any authorized computer or device on the network (WAN or LAN).

Business Logic Tier: is the middle tier which ensures the communication and the smooth traffic between the server application and clients. This layer protects more the database tier from possible attack as it prevents a direct connection to it

Database Tier: where data are stored in a database named diagnostic. Several tables respecting the relational aspect are created in a way to avoid duplicate or redundant data (Fig 3).

A three-tier solution is scalable and presents a secured way to handle sensible data.

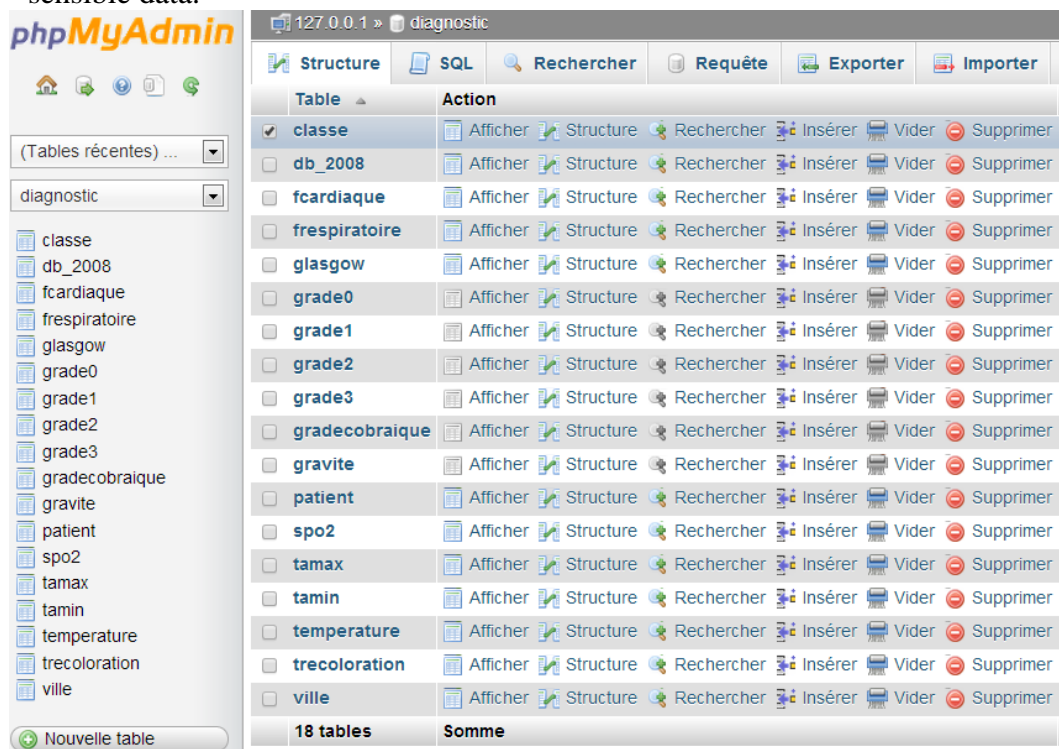


Fig 3: Diagnostic-database overview

The different tables interact with the user interface and contain patient's health information. Only authorized healthcare professionals can add, modify or view this information

D. Health indicators:

The selected indicators are simple, easy to calculate and allow keeping track of the changes in morbidity and mortality. Below are the used indicators in the study:

- Post Sting Time : PST , which is the time between the sting and the patient's arrival at the health center (Soulaymani R. et all, 2004)
PST = admission Time – sting time
- The sex ratio is the proportion of male sex on the female sex : F/M
- The poisoning rate is the proportion of stung patients (class II, III) among hospitalized patients (Class I, II and III) during the monitoring period :

Poisoning rate= patients (CII+CIII)/patients (CI+CII+CIII)

- Fatality rate by poisoning (TLE) is the proportion of deaths among stung patients (class II and III) during the monitoring period in the hospital (Soulaymani R. et all, 2002)

Following a scorpion sting, the CAPM uses stung patients health records to collect all related information (Ouammi et all, 2009). We developed a graphical interface to collect the patient information (Fig 4), which will be saved in a relational database.

- Health record number: the number of the patient's folder
- The admission number: is the number of admission to hospital
- Personal Information: Name, Sex, Age and Weight
- Information about the sting: the date and time, scorpion type
- Admission: date (day / month / year) and time
- Patient referred or not: If yes, the reference sheet should be attached
- A health records history of the patient (e.g: the existence of permanent diseases...)
- Class admission: it is the level of prioritization of the patient, it can differentiate from simple sting (class II) to severe poisoned sting (class III). Not serious one is designed as Class I
- Para clinical examinations: to assess the biological disturbances and cure them
- Final Evolution: Favorable state (note the date and time of patient's discharge) or fatal (if the patient died, note the date and time of death and must specify the consequences).

Fig 4: Graphic interface to record a new stung patient

E. Monitoring Model:

Recording and obtaining vital signs of a patient is one of the most important performed tasks by a medical agent. This includes essentially temperature, pulse (heart rate), respiration and blood pressure. The regular monitoring may help measuring the patient response to treatment.

The monitoring model is a table with the following patient's information (Ouammi et al, 2009):

- Patient's personal information
- The service name, the patient's admission date and time
- Clinical signs are monitored every 30 minutes
- Blood pressure (maxima / minima)
- Temperature (° C)
- Heart rate (beats / min)
- Respiratory rate (cycle / min)
- Respiratory rate (cycle / min)
- Glasgow (3-15) (Fig 5 shows the used interface to calculate Glasgow score).
- Class (I / II / III) (schematized in the previous Fig 1).
- The diuresis (ml / min / 24)
- The given treatment (drug, dose...)

- Evolution: favorable, Vitale Distress (Cardio, respiratory, Neuronal) or Death (Biswal et all, 2006).

Glasgow Coma Score

Eye Response:

- ☐ Spontaneously
- ☒ Opening to verbal command
- ☐ Opening to pain
- ☐ No eye opening

Motor Response:

- ☐ Obeys commands

By pain

- ☒ Localizes
- ☐ Withdrawal
- ☐ Flexion
- ☐ Extension
- ☐ No motor response

Verbal Response:

- ☒ Oriented
- ☐ Confused
- ☐ Inappropriate words
- ☐ Incomprehensible sounds
- ☐ No verbal response

Calculate

Message de la page Web

Interpretation:

13

OK

Fig 5: Interface to calculate Glasgow score

The hospitalization sheet is used to record the corresponding values periodically. Vital signs can be supervised in a numeric or graphical form, combined (Fig 6) or separated (Fig 7).

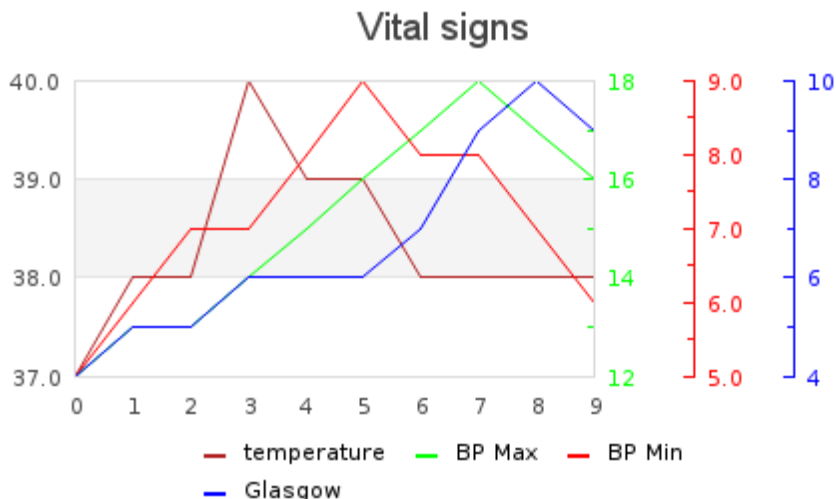


Fig 6: Combined graphical representation of vital signs

For detailed investigation and based on the available database records, the information system is able to represent the different vital signs values separately. Example of Glasgow graph is illustrated in Fig 7.

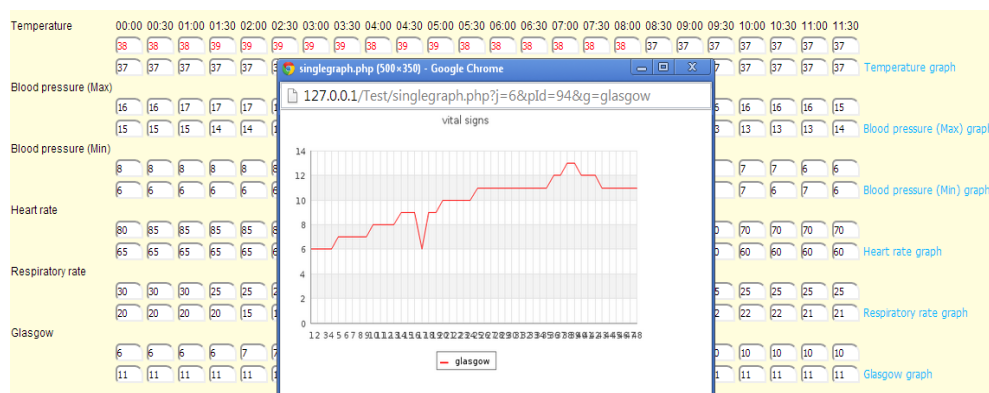


Fig 7: Graphical representation of Glasgow scores

Results and Discussion:

This platform imparts reflectivity, reliability and speed to advance the diagnostic and the treating of stung patients. The Three layers architecture ensure security, this is strengthened by the SSL implementation supported by Apache Web-server.

Clinician can constantly follow up the different vital signs like blood pressure, temperature, heart or respiratory rate. This helps them to take straightaway the efficient and effective action. Graphical representation is often more effective than presenting data in list or tabular form

The new developed monitoring model is constructed in such a way that allows supervising the health status and their evolution. Based on that progress the system is able to suggest proposition of drugs or treatments to the clinician.

Create, update and delete patient's entries is guaranteed, however each modification is registered in the database. The administrator can determine who deleted, modified or restored data across the application. Reports in multiple forms (xml, csv , xlsx or html) and statistics can be generated by each user possess administrator or analyst privileges.

Thanks the FPDF class, when a stung patient needs to be transferred to a foreign service (like an ICU). On demand a PDF file is generated automatically, it contains all relevant data and can be printed or sent by mail.

Autocomplete function makes it easy to find or search for an entry in the database, the end user has then only to select the suitable choice (Fig 8).

The screenshot shows a search interface on a light blue background. At the top, a text prompt reads: "To search for a patient, please enter First name, Last name or Hospitalization number :". Below this, there are three input fields labeled "First name", "Last name", and "Hospitalization number". The "Last name" field contains the text "rac" and has a dropdown menu open below it. The dropdown menu lists three suggestions: "Rachida", "Rachidaa", and "rachid". The "Rachidaa" option is highlighted with a dark blue background. To the left of the dropdown menu is a "Search" button with a magnifying glass icon.

Fig 8: Autocomplete function by the search for a user

The following diagram (Fig 9) shows an overview of the different functions available for an authenticated user in the developed application. The platform is supposed to assist the target personnel accomplishing their daily tasks.

When logging in, the system differentiates between an administrator and a non-administrator. Non authenticated users are redirected to the home page. For users with administrative privileges, they are allowed to track, manage and analyze the patient's stored data like:

- Morbidity ratio
- Lethality ratio
- Sexe ratio
- Envenomation rate
- PST
- Severity management
- Symptoms maintenance
- Diagnostic maintenance

- Database maintenance
- Export data from DB
- Import data into DB

The health professional's members (normal users) are able to manage the daily tasks like:

- Create, modify, delete or print the patient information.
- Visualize the different vital signs graphics.
- Calculate the Glasgow score

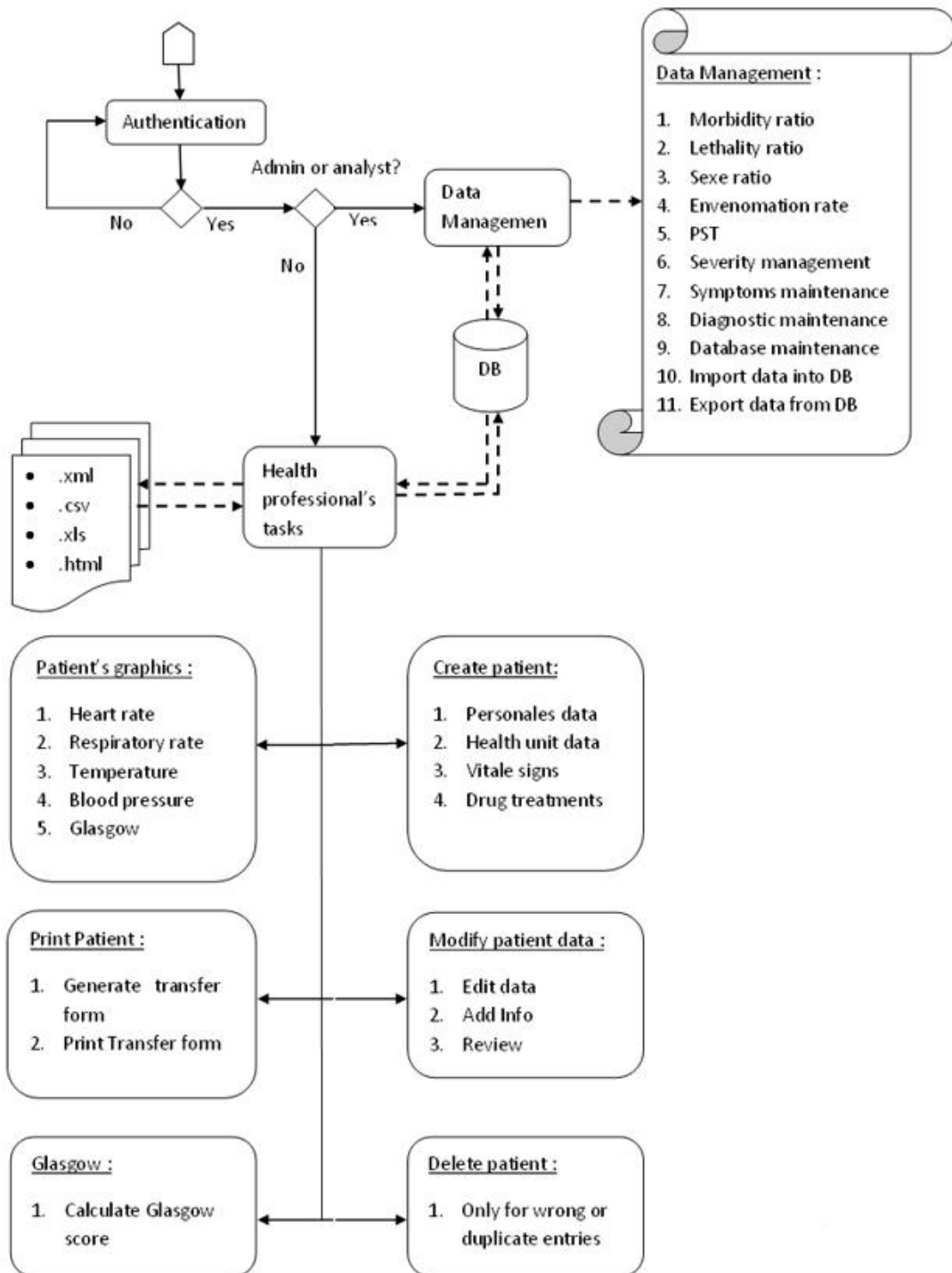


Fig 9: General overview of available functions

Conclusion

Health care professionals are often skeptical and show little support for the eHealth because technology does not seem to work for them or the benefit of their patients (Chaudhry et al, 2007). As a result, eHealth technologies often face adoption problems (van Gemert-Pijnen et al, 2011). The ultimate goal is to realize a motivating platform that can support measurement, monitoring, guidance, management of data and their analysis.

As of now in Morocco, information about all types of poisoning is collected and stored nationally by the health staff in a centralized “database” in the CAPM in Rabat (Ezzerrifi Amrani et al, 2012). In this paper we highlighted the importance of having a centralized health system; the implementation of such solutions offers an automatic process that would allow the clinician to treat the stung persons efficiently and quickly. The developed application offers real and actual statistics, so the health operators can take in anytime the adequate measures to define their strategies especially to reduce the mortality rate of patients.

Modeling the vital signs and their evolution in case of an envenomation worth a deeper study to discover the possible impact on the final evolution of a stung patient. Development and integration of such eHealth technology in the sector is a main part of realizing a sustainable innovation in the health care practices.

Finally, it is equally important to mention that the deployment of such tools is time-saving and will allow the health professionals to benefit from various advantages like: live monitoring, accessibility, security, ability to share information, data and images transportation and organizational efficiency.

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